

Testing automated driving functions with maximum complexity

- ▶ Swarm tests place high demands on vehicles
- ▶ Any traffic scenarios can be simulated
- ▶ Transferring virtual tests into reality

The LAURIN research project is taking stock at the halfway point: its aim is to digitize and automate scenario-based testing at the DEKRA Lausitzring to safeguard automated driving in the future. In the process, so-called swarm tests are used to simulate traffic scenarios of any complexity to subject the vehicles or driving functions to be tested to maximum requirements. The experts recently presented the interim status at an expert conference.

A key component of the project is to be able to reproduce virtually any real road situation or scenario on the test tracks at the DEKRA Lausitzring. The basis for this is the existing variety of tracks, first and foremost the new flexible city courses opened last summer. "With DEKRA's expertise and our test equipment, the scenarios can be reproduced in a reproducible manner", explains consortium leader Felix Kocksch.

Real accident scenarios as a basis

Under the leadership of project partner Fraunhofer IVI, it was demonstrated how accident scenarios, which were elaborately prepared from real police accident reports, can be reconstructed from a database at the test site. "In this way, we can test assistance systems or automated driving functions in demonstrably critical situations. A real accident event can thus be recreated in a test with a modern assistance system,

with the system proving that it can prevent the accident”, says Kocksch, describing a concrete example shown during the mid-term review.

The test sequences can be automated to a high degree. They form the basis for testing future functions of so-called cooperative networked and automated mobility. “One example of this would be how, in the future, infrastructure such as a traffic light will also be integrated into the scenario and send information to vehicles or other road users – for example, about traffic light phases or about objects detected by sensors in the infrastructure”, says the consortium leader. In the second half of the project, research work will be targeted in this direction, among other things.

Swarm tests in reality and with the digital twin

In addition to the test tracks, the swarm test methodology forms the second main pillar of the LAURIN research project. The concept has been extensively developed since the start of the project. Among other things, the process is underway to precisely digitize the test site. “The basic survey of the site with high-precision surveying technology has been carried out”, explains Kocksch. When a concrete scenario – for example, in terms of route layout and lane markings – is set up in reality, this allows corresponding HD maps to be created quickly and flexibly from drone photos.

The scenarios can thus be carried out both in reality and with the so-called digital twin of the test site. Thanks to the software of project partner TraceTronic, the maneuvers of the moving objects can be conveniently created in the simulation. “This opens up optimal possibilities for us to compare the real tests with virtual tests and make them directly comparable”, says the consortium leader. A connection for automated test case evaluation was also tested in the project.

Another important building block for scenario-based testing in a swarm is the 5G campus network. Large areas of the test site at the DEKRA Lausitzring are already covered by a private 5G network; further expansion is underway. Project partner Smart Mobile Labs is working on configuring the 5G infrastructure to meet requirements.

The experts demonstrated how all this works together with a swarm test involving six participants at the “ADAS Experience” event held by carhs GmbH at the end of September 2023. The first participant was the vehicle under test, a car equipped with modern assistance systems. In addition, there were two series-produced vehicles controlled by driving robots, one vehicle whose actuators are controlled remotely via electronic signals (“by wire”), and two drive-over platforms that used soft targets to simulate another passenger car and a cyclist. “Controlling the interaction of moving objects in the test scenario with pinpoint accuracy and thus making it reproducible is the major challenge here, and we have shown in the project that it works”, says Felix

Kocksch. For this purpose, project partner iMAR is further developing its control station solution, which is already being used to centrally orchestrate and monitor all objects. The goal is to ultimately be able to apply the methods being tested in the LAURIN project to swarms with up to twelve objects.

In the further course of the research project, it is now a matter of further linking the individual components developed so far and transferring them into an integrated overall concept, according to which the highly complex tests for safeguarding automated driving can be carried out in everyday test operations in the future.

The LAURIN research project

The LAURIN research project was launched in May 2022 and is scheduled to run for three years. Consortium leader DEKRA is working on the project together with the Fraunhofer Institute for Transportation and Infrastructure Systems IVI (Dresden), iMAR Navigation GmbH (St. Ingbert), Smart Mobile Labs AG (Munich) and TraceTronic GmbH (Dresden). A total of around € 4.2 million is being invested in the project. It is being funded with a total of € 2.45 million by the German Federal Ministry for Digital and Transport as part of the mFUND innovation offensive.

Picture caption

Swarm tests at the DEKRA Lausitzring are used to put vehicles with automated driving functions into highly complex traffic situations to ensure that they function safely in real traffic. In the LAURIN research project, the methods are being developed so that the tests can be carried out in a reproducible and directly comparable manner both in reality and in simulation.

Video reference

A video on the swarm test methodology, which is being developed as part of the LAURIN research project, is available at <https://youtu.be/i30ITt8wa-U>. A test with an emergency brake assistant when turning can be seen at https://youtu.be/J_Yjk_Iz8WE.

About DEKRA

DEKRA was originally founded in 1925 to ensure road safety through vehicle inspection. With a much wider scope today, DEKRA is the world's largest independent non-listed expert organization in the testing, inspection, and certification sector. As a global provider of comprehensive services and solutions, we help our customers improve their safety, security, and sustainability outcomes. In 2022, DEKRA generated sales totaling nearly EUR 3.8 billion. The

company currently employs almost 49,000 people who offer qualified and independent expert services in approximately 60 countries on five continents. With a platinum rating from EcoVadis, DEKRA is now in the top one percent of sustainable businesses ranked.

About the BMDV's mFUND:

As part of the mFUND innovation initiative, the German Federal Ministry for Digital and Transport (BMDV) has been funding data-based research and development projects for digital and connected mobility 4.0 since 2016. Project funding is supplemented by active professional networking between stakeholders from politics, business, administration, and research and by making open data available on the mCLOUD portal. For more information, visit www.mFUND.de.